Pedagogical approaches to mathematics teaching in multicultural classrooms.

Resources and materials developed in the IncluSMe Project.

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Webside of IncluSMe project
https://inclusme-project.eu

IncluSMe
Intercultural learning in Science and Mathematics initial teacher education

Co-funded by the Erasmus+ Programme of the European Union

Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education

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Learning in an intercultural environment. Photo: IncluSMe

IncluSMe

Erasmus+ project

Aims and actions

Intercul**l**tural **l**earning in **S**cience and **M**athematics **e**ducation

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What IncluSMe was?

Learning in an intercultural environment.
Photo: IncluSMe

- Participating 11 countries
  - Germany was the leading organization (Freiburg Institute)
  - In Greece the partner was Mathematics Department of NKUA
- It lasted for 3 years (2016-2019)

IncluSMe aims

- IncluSMe contributes to making the initial education of prospective maths and science teachers more relevant and more adapted to societal challenges of an increasingly diverse Europe.

- In the long run, culturally sensitive maths and science teaching will have great impact on educational progress of immigrant and refugee youth in general and open up opportunities for their social participation.

The prospective mathematics and science teachers are expected to …

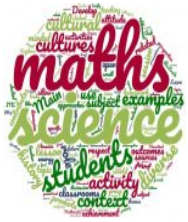
- **Identify issues** related to mathematics teaching and learning through **classroom scenarios** *(e.g., extracts from classroom dialogues, interviews with teachers and student in multicultural settings).*
- Read **research literature** on pedagogical approaches and teaching methods suitable to deal with diversity, heterogeneity, multilingualism and to create equal opportunities for pupils in mathematics and science learning.
- ***Design teaching interventions*** on the basis of resources *(e.g., curriculum materials, textbooks, research findings).*
- Reflect on their teaching designs and consider changes that they would make.

The systemic character of IncluSMe project

- Every partner is responsible for designing one module.
- All the modules will be interconnected in order to develop an undergraduate course in Mathematics and Science Teacher Education.

(some of) IncluSMe modules

Module 1
INTRODUCTION TO CULTURE AND DIVERSITY FOR PROSPECTIVE MATHEMATICS AND SCIENCE TEACHERS



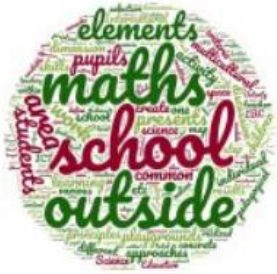
Module 2
CULTURE-RELATED CONTEXTS FOR MATHEMATICS AND SCIENCE

Module 4
SOCIO-SCIENTIFIC ISSUES

Module 5
DIFFERENT PERSPECTIVES ON CURRENT ECOLOGICAL PROBLEMS

Module 6
PEDAGOGICAL APPROACHES TO MATHEMATICS AND SCIENCE TEACHING IN MULTICULTURAL CLASSROOMS

Module 12
Assesmment in Mathematics and Science in Multicultural Contexts



Module 10
Intercultural Mathematics Learning Outside of School

Module 6

PEDAGOGICAL APPROACHES TO MATHEMATICS AND SCIENCE TEACHING IN MULTICULTURAL CLASSROOMS

Illustrative activities

Pedagogical approaches to teaching and learning mathematics in multicultural classrooms

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Sharing experiences

- Asking prospective teachers to discuss relevant experiences they have from lessons in multicultural classrooms
- Focusing in teachers' anxieties and dilemmas
  - e.g., What challenges do you think that a teacher who teaches in a multicultural classroom usually meet?

Comment on real classroom scenarios

- Asking prospective teachers to identify teachers' pedagogical approaches while teaching in intercultural classrooms through the reading of specific classroom real episodes

Classroom scenario 1: Teaching adding and subtraction numbers from 1-20.

Setting: We are in a Reception Structure for Educating Refugee students in a small Greek town. All students do not speak Greek.

The teacher has already taught how to add natural numbers up to 20. The teacher comments as follows:

> Teacher: I used the number line from 1 to 20 and it worked. Pupils can easily solve problems like 10 plus something equals 15. … We first learn numbers orally, before writing them with symbols. We express the numbers in English, then in Greek and then pupils say the numbers in their own language. They asked me to repeat the numbers in their language even though my pronunciation is not always right.

What teaching practices do you recognize here?

Classroom scenario 2: How a Primary teacher helps two students to understand and solve a word problem

Setting: We are in urban Germany where Amir and Ekim, two 12-year-old boys, attend 6th grade. Both students have Turkish as their first language, below average performance in mathematics and limited language proficiency in German. The teacher speaks only German.

The following excerpts come from an episode where Amir and Ekim are trying to solve the following word problem:

The task: ***According to a UN (United Nations) report, 1/4 of all adults in this world are analphabets, that means, they cannot read and due to this they cannot learn many professions. In addition, the 2/3 of all analphabets are women. What part of all adults in the world are analphabet women?***

After Amir and Ekim had read the problem, the teacher talked to the students about analphabets and asked from them to **rephrase the problem in their own words**.

Ekim	Oh wait, shortly. One quarter
Amir	Loud!
Ekim	Of one quarter are two-thirds…
Amir	Women …
Ekim	Who cannot read. Eh, we will write: thereof are two-thirds. No, don't think so. There of are tw-two-third [whispering], [louder:] two thirds women, who cannot read.

The teacher realizes their difficulty to express verbally the problem so he suggests them to represent the data given graphically. The students make the following square	
Teacher	**What does the whole square represent?**
Ekim	Well this [hints to the whole square] are all adults and that [hints to the red quarter] are all adults who—cannot read exactly. who cannot read. And thereof, now two-thirds are women who cannot read

T	**Mhm. [agreeing] Do you draw that, too? Can you draw that into it?**
Ekim	Two-thirds
Amir	Thirds. [break 4 sec] Yes.
Ekim	Shall we do that here? [hints to the red quarter , but the Teacher does not react. Ekim answers himself without any break] Yes, don't we? We must do that.

Study the relevant research literature

Mathematical language: different forms of representations of mathematical notions

The construction of meaning of mathematical ideas calls for the participation in mathematical activities and assigning meaning to linguistic, graphical and symbolic aspects of these activities. Models of teaching that aim at establishing connections between different forms of representations of mathematical ideas and processes have gained momentum in the decades passed (Fig. 2.1).

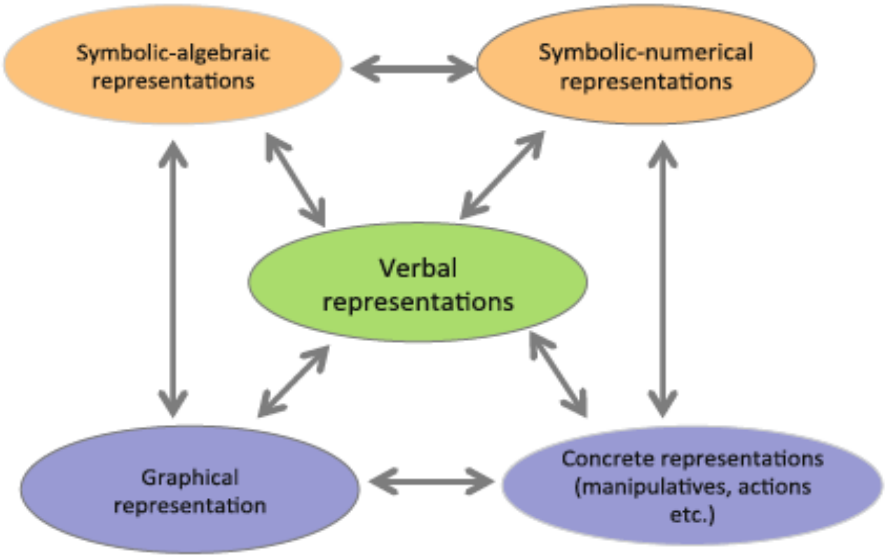


Fig. 2.1 Different forms of representation (Prediger, Clarkson, & Bose, 2016)

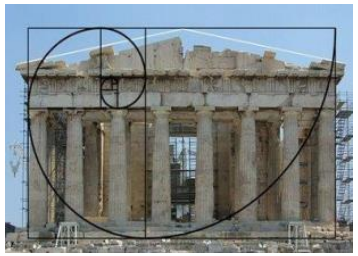
Design teaching interventions

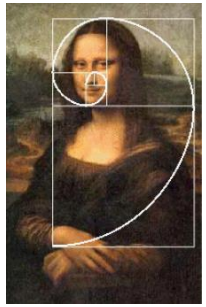
- **Coding prospective teachers' suggestions in task designs:** resources used /**mathematical notions**

1) **The use of visual representations**

- photos from coins/ flags/figures for teaching the notion of circle

- classical art designs for teaching the notion of Golden ratio & symmetry.

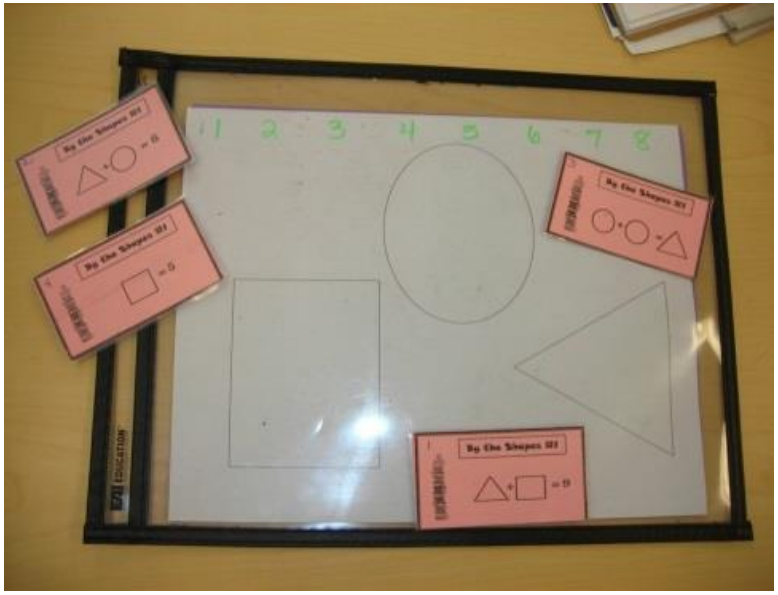




2) The use of cards

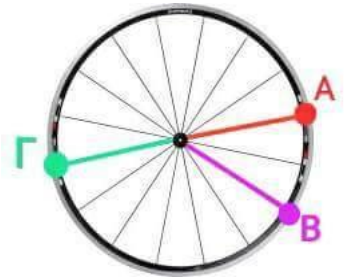
with geometrical features

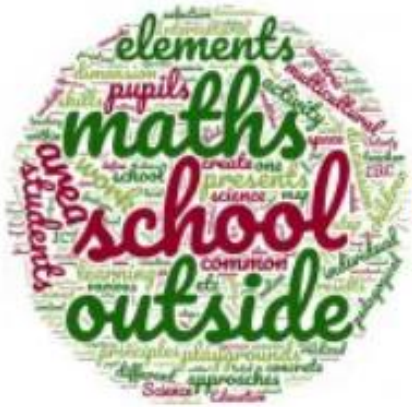
- When teaching the solution of system of linear equations



3) The use of every day material

- Bicycle wheel for teaching the notion of radius and diameter.
- Scale and food products for teaching linear equations.





Module 10

Intercultural Mathematics Learning Outside of School

Illustrative activity

Main activity: the students act as ARCHITECTS and create their own playground

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- Presenting a video about playgrounds in Ethiopia.
- Commenting about its characteristics
  - looking for similarities and differences with their own playgrounds

a) Tasks and discussion

Discussion: imagining the ideal playground

b) Select areas for new functional use and define priorities

- Decisions students had to take
  - replacement or reparation of existing equipment's?
  - enrichment of existing playground with new elements?
  - Or design a new playground?

C) Creating criteria for proposals

Examples of criteria given by teams of pupils:

- use, safety, cost, durability, aesthetic appearance ...

Critical questions at the end of the activity: Relate the task with aspects of multiculturalism

- How can a multicultural target group of children influence the process of planning and creating a playground?
- Which phases of the playground design and building will be the most affected by the multicultural target group of children?
- How intercultural approaches involving designers (architects) from different cultures can influence a playground design?

Module 12

Assesmment in Mathematics and Science in Multicultural Contexts

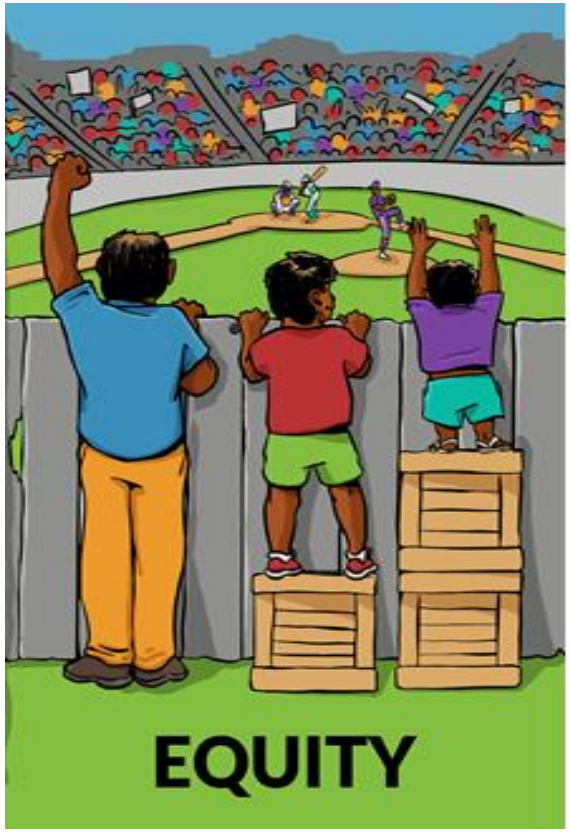
Illustrative activity

Assessment in multicultural settings

Activity: what is a fair assessment?

Critical questions:
What does this picture show?
Is it fair?
Do you think that you can make it fair?

Who sets the rules (i.e. the height of the fence)?
How the teacher can 'raise' the rules?

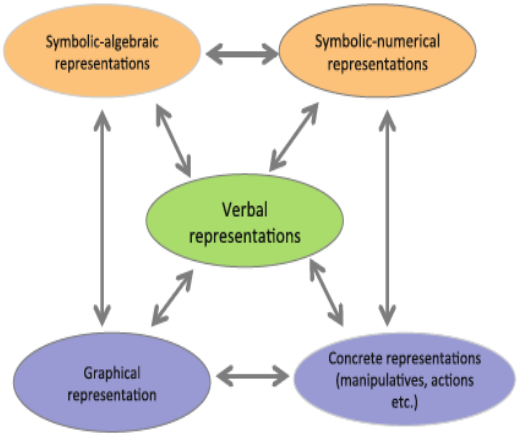


Problematize prospective teachers about the notions of Equality & Equity

Equality aims to ensure that everyone gets the same things in order to be able to achieve their full potential in assessment.

Equity means ensuring that everyone has access to the resources and opportunities that they need to achieve their full potential in education.

Trying to summarize: Pedagogical approaches in multicultural classrooms



- Using multiple representations.
- Asking students to represent graphically their ideas instead of verbally explaining it.
- Comparing common children practices (*e.g., playgrounds)*
- Designing tasks that they include every day material *(e.g., scale and food products).*
- Posing critical questions.
- Providing students the resources and opportunities that they need to achieve their full potential in education.
- …

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